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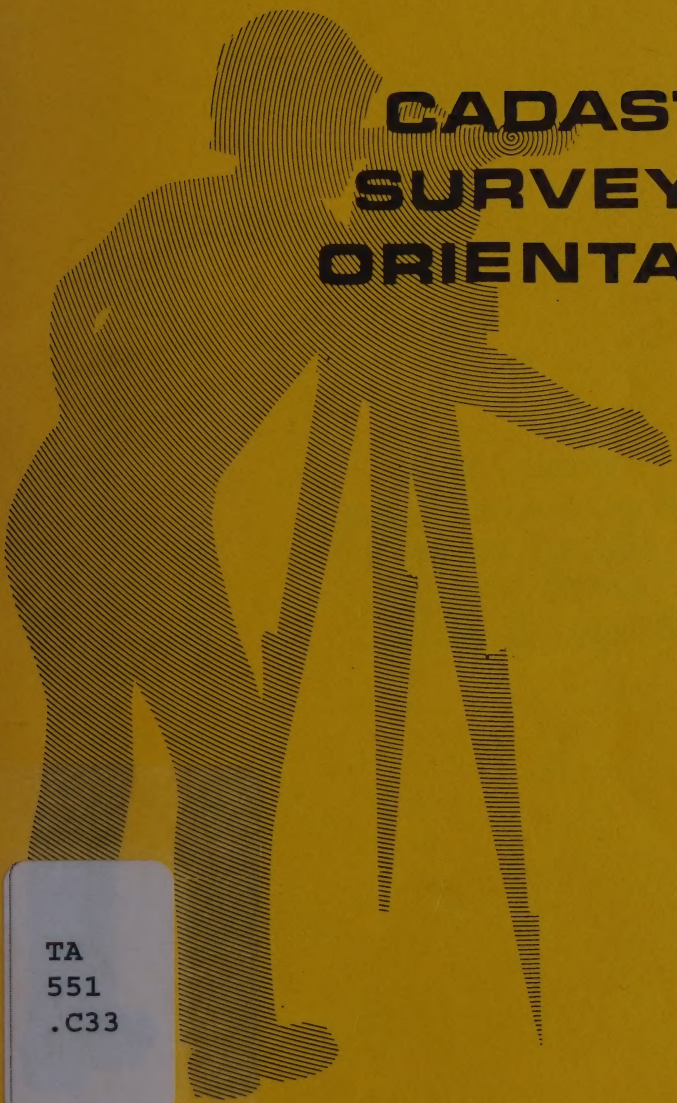
BUREAU OF LAND MANAGEMENT

CADASTRAL SURVEYOR'S ORIENTATION



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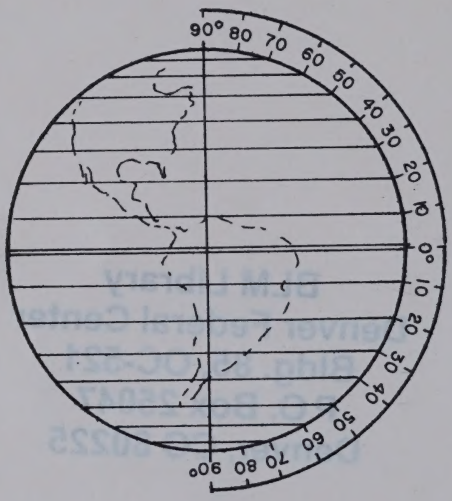
Latitudes and Longitudes are measuring lines used to identify geographical positions anywhere in the world. Any point on the earth's surface can be identified precisely by reference to these lines. They cover the earth, by degrees, with a gridwork of north-south and east-west lines. Pin-point geographical measurements are made possible by the use of degrees and their smaller fractions. A full circle contains 360 degrees. Each degree contains 60 minutes, and each minute contains 60 seconds.



LATITUDES

Latitude lines circle the world parallel with the equator. These lines are identified by their position either north or south of the equator. The degrees of latitude increase as one proceeds from the equator toward either north or south pole where the latitude is 90 degrees. California lies between latitude 32 degrees and latitude 42 degrees north of the equator.

LONGITUDES

Longitude lines run north and south. Each line is identified by its number of degrees east or west from the starting point at Greenwich, England. Thus, there are 180 degrees west and 180 degrees east of "zero" meridian at Greenwich. Each degree represents 69.17 statute miles at the equator. This distance applies only at the equator as the distances between longitudes gradually diminish approaching the poles, like orange peel segments. The International Date Line (for most of its length) is at the 180-degree longitude, or directly opposite Greenwich.

PUBLIC LAND SURVEYS

The U.S. Rectangular System of surveying public lands had its true beginning with action by the Continental Congress in 1784, with survey work starting in Ohio in 1786. This congressional act required that all lands in the Public Domain not previously surveyed be divided by north and south lines running on a true meridian and by others crossing them at right angles so as to form townships six miles square. In addition, each township was to be divided into sections, each containing one square mile, or 640 acres.

This process involves these basic actions:

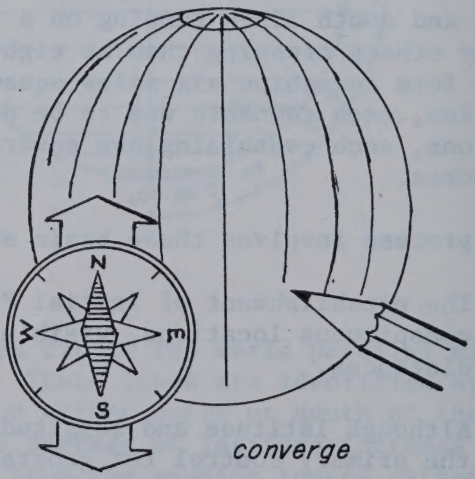
A. The establishment of Initial Points at conspicuous locations, visible for great distances.

   Although latitude and longitude provide the primary control for geographical identification, the U.S. Land Survey System employs a more localized system for land descriptions. Prominent geographical points are selected as the origin of these systems.

It should be noted that the following initial points were chosen for the west coast of the United States: Willamette Meridian, Willamette Stone on the west boundary of Mt. Calvary Cemetery in Portland, Oregon; Humboldt Meridian, Mt. Pierce in Humboldt County, thirty miles south of Eureka, California; Mt. Diablo Meridian, thirty miles east of San Francisco, California; San Bernardino Peak, twelve miles north of Beaumont, California; and Gila and Salt River, five miles west of Phoenix, Arizona.

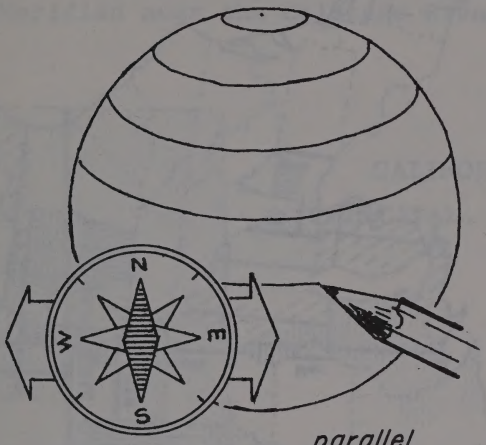
B. Lines were run through these initial points, extending both north and south therefrom, on true meridians. These lines are called Principal Meridians, sometimes referred to as Prime Meridians.

MERIDIAN LINES



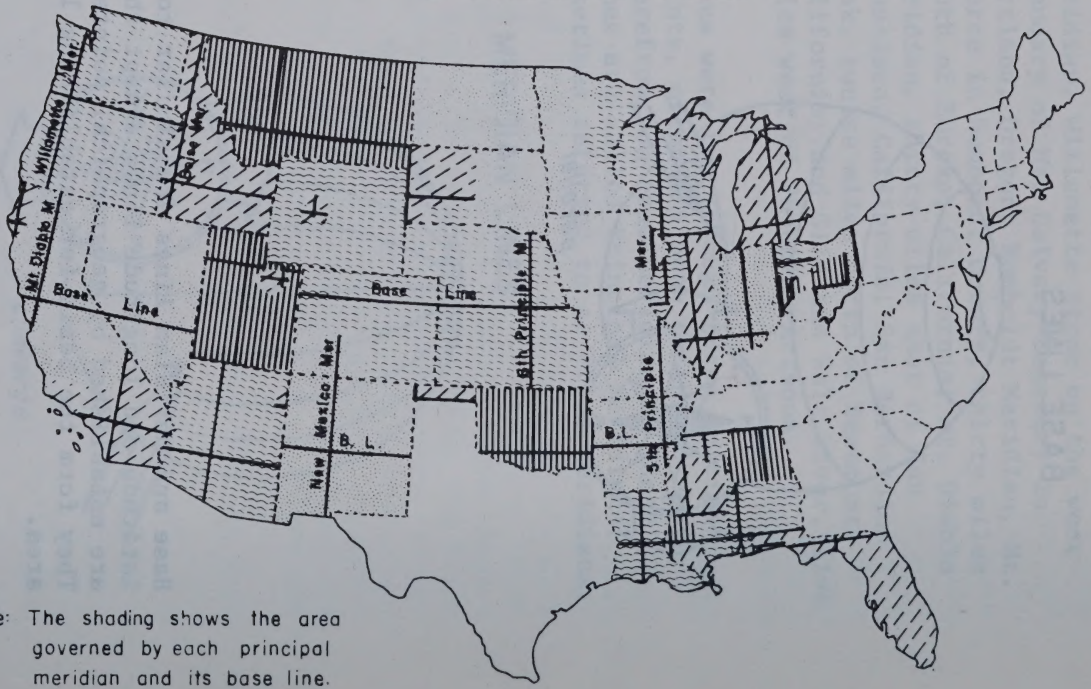
Lines were also run both east and west on a true parallel of latitude and are called Base Lines.

BASE LINES



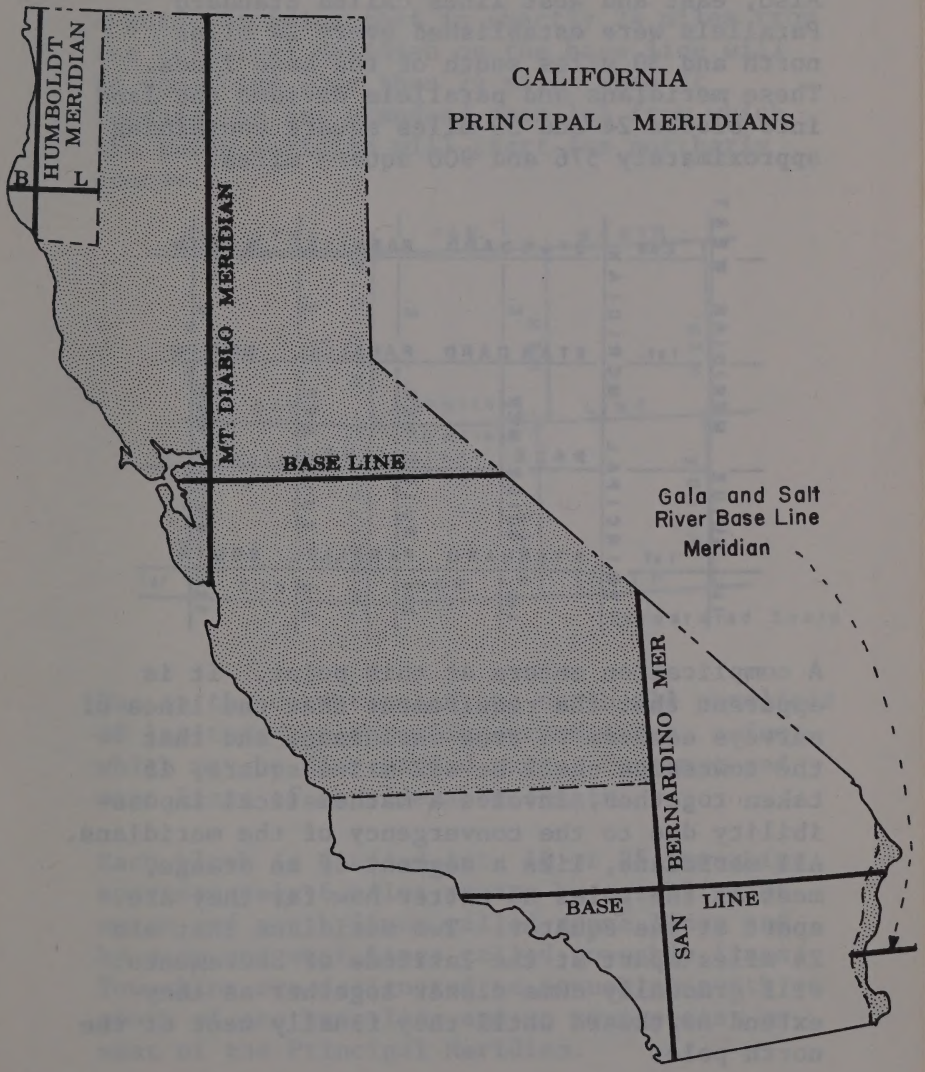
Base and meridian lines are similar to latitude and longitude lines except they are established by geographical points. They form the basis for establishing land area.

PRINCIPAL MERIDIANS OF THE FEDERAL SYSTEM OF RECTANGULAR SURVEYS



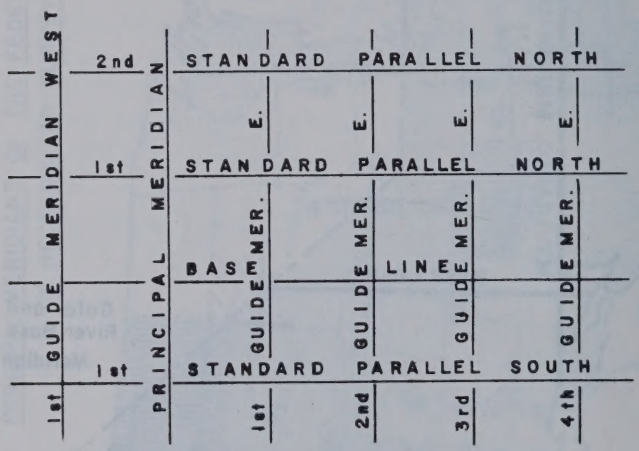
Note: The shading shows the area governed by each principal meridian and its base line.

In California there are four of these systems. The Humboldt Meridian centered near Eureka, the Mt. Diablo Meridian centered on Mount Diablo, the San Bernardino Meridian centered near the City of San Bernardino, and the Gila and Salt River Meridian near the Colorado River.



Through each of these points of origin there is established a gridwork of townships surrounding the point of origin. The east-west latitudinal lines through these points are called base lines. The north-south longitudinal lines through points are called meridians.

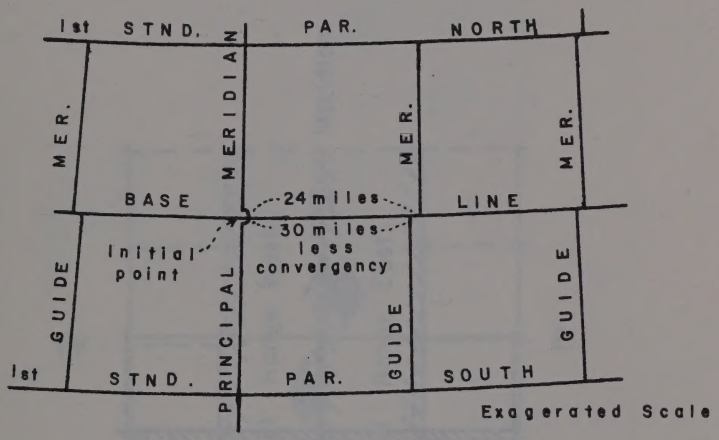
Also, east and west lines called Standard Parallels were established every 24 miles north and 30 miles south of the base lines. These meridians and parallels divided the land into blocks 24 and 30 miles square containing approximately 576 and 900 square miles.



A complication enters at this point. It is apparent that the requirement that the lines of surveys conform to true meridians, and that the townships shall be six miles square, if taken together, involve a mathematical impossibility due to the convergency of the meridians. All meridians, like a segment of an orange, meet at the poles no matter how far they are apart at the equator. Two meridians that are 24 miles apart at the latitude of Sacramento will gradually come closer together as they extend northward until they finally meet at the north pole.

To conform the north and south township lines to the true meridian produces townships of trapezoidal form which will not contain the precise area of 23,040 acres, or 36 square miles. This discrepancy increases in the convergency of the meridians as the survey attains higher latitudes.

A guide meridian that is exactly 24 miles from the Principal Meridian on the base line will be something less than 24 miles when it reaches the 1st standard parallel from which the guide meridian will start its northerly course.



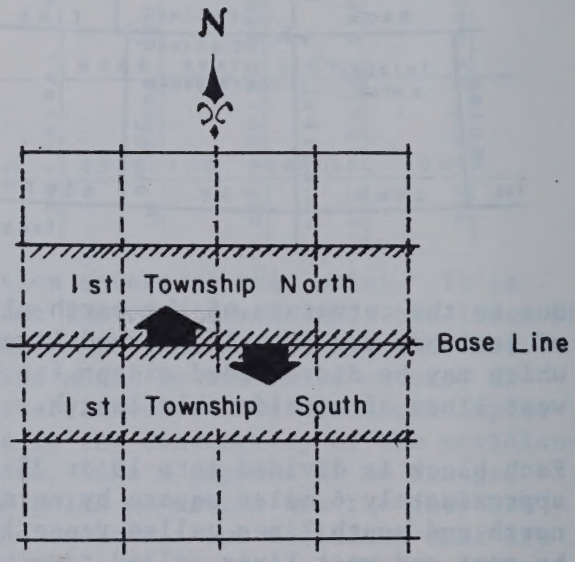
Due to the curvature of the earth all parallels of latitude are actually curved lines, a fact which may be disregarded except for east and west lines of considerable length.

Each block is divided into 16 or 25 townships approximately 6 miles square by establishing north and south lines called range lines and by east and west lines called township lines. Townships are designated as townships north or south of the base line and as ranges east or west of the Principal Meridian.

TOWNSHIP

Townships are rectangular blocks of land theoretically six miles square. They have no connection with townsites or towns. Starting from a base line, there are tiers of townships paralleling the base line. These tiers are numbered according to their position north or south of the base line.

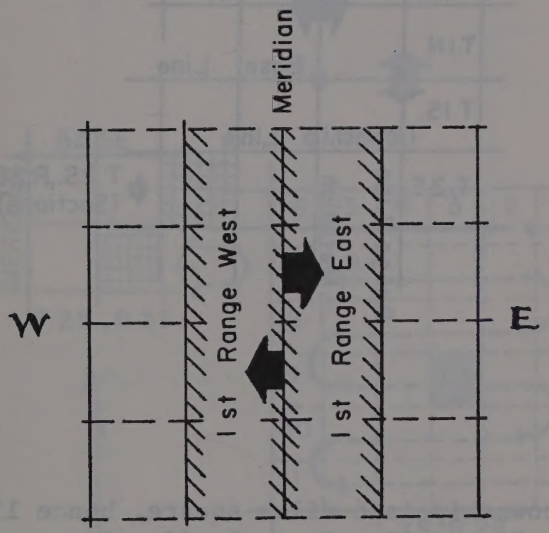
Example: The second tier of townships south of a base line is identified by the abbreviation T. 2 S. (Township 2 South).



RANGE

Starting from the meridian through the point of origin of each system there are columns of townships called ranges, east and west of the meridian, numbered progressively away from the meridian.

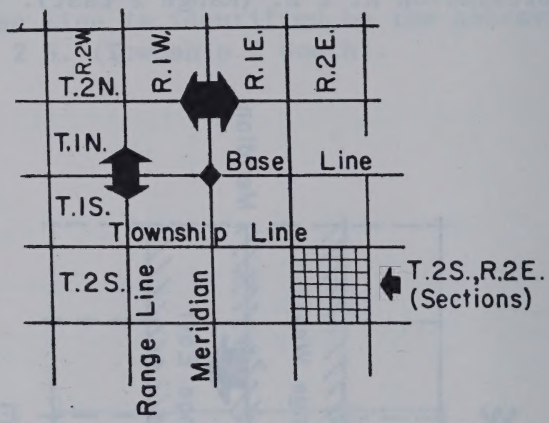
Example: The second range of townships east of the meridian line is identified by the abbreviation R. 2 E. (Range 2 East).



Any particular township may be found by identifying first its township number, second its range number, and third its base and meridian system.

Example: T. 2 S., R. 2 E., M.D.M. (Township 2 South, Range 2 East, Mt. Diablo Meridian).

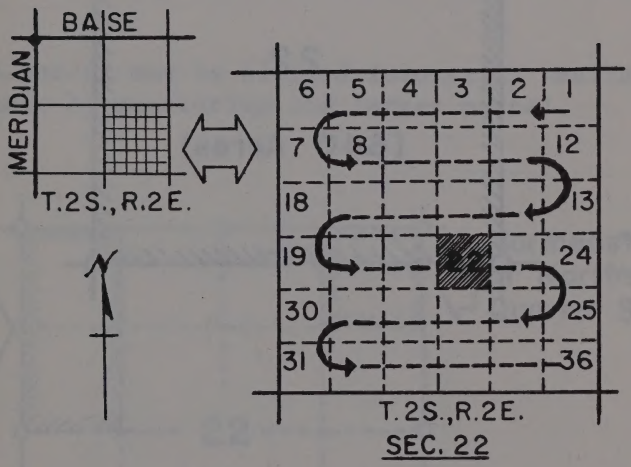
It can readily be seen that given a township and range, one can determine approximately where a piece of property is located. A section of land in Township 15 North, Range 10 East, M.D.M., would be roughly 90 miles north of, and 60 miles east of Mt. Diablo.



Each township is 6 miles square, hence 15 x 6 equals 90 and 10 x 6 equals 60. On an ordinary road map drawn to the usual scale of one inch to twenty miles, 90 miles will be 4½ inches and 60 miles will be 3 inches. By measuring 4½ inches north of Mt. Diablo and 3 inches to the east of the 4½ inch mark, a position will be found near Baxter on Interstate 80 between Colfax and Truckee.

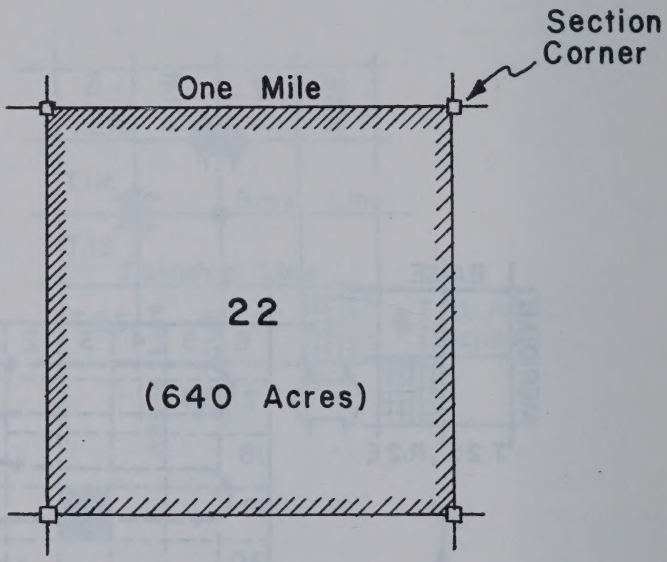
SECTIONS

A township is further divided into 36 sections. Theoretically each section contains one square mile. Sections are numbered consecutively starting with 1 at the top right or northeast section, thence progressing alternately westerly and easterly through successive tiers of sections ending at number 36 in the southeast corner of the township.

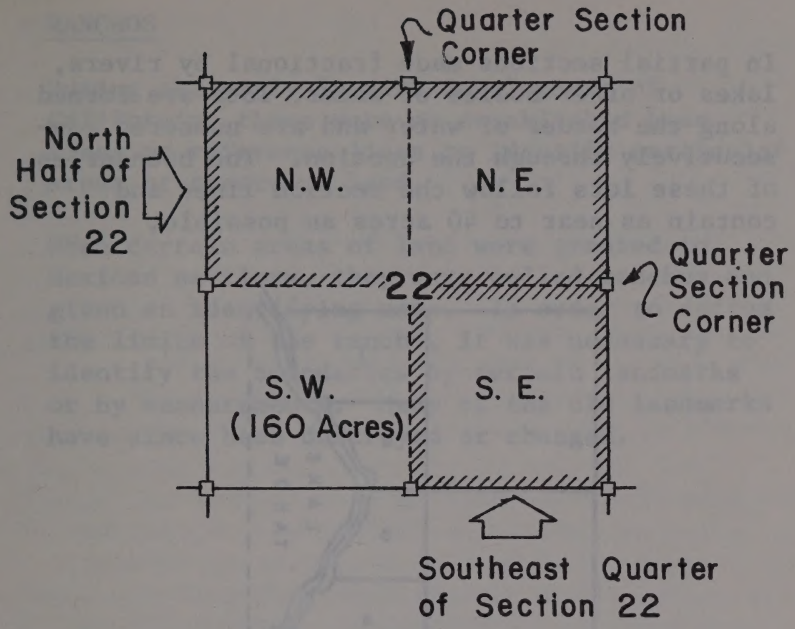


S2	S1
S11	S12

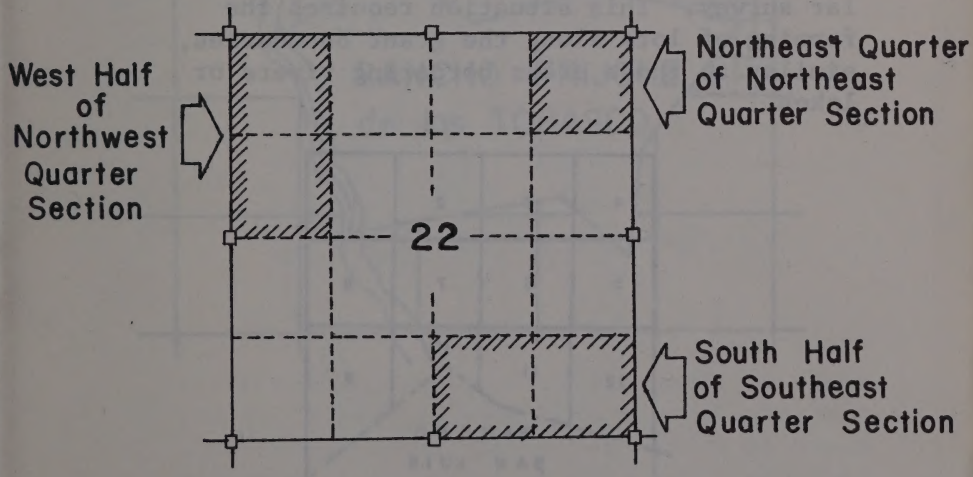
There are thousands upon thousands of sections numbered 22. But there is only one Section 22, for instance, in Township 2 South, Range 2 East of the Mt. Diablo Meridian system. No section can be identified without referring to its number, township, range and base and meridian.



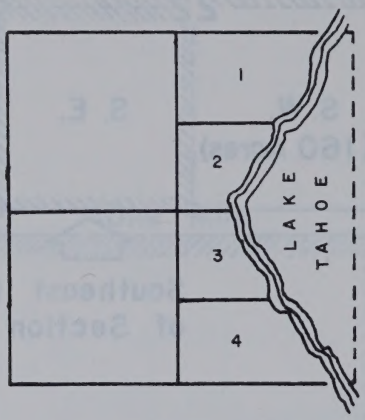
Each section can be divided into smaller parcels. The regular portions of sections are called aliquot parts. They are defined by quartering the section or the larger parts of the sections.



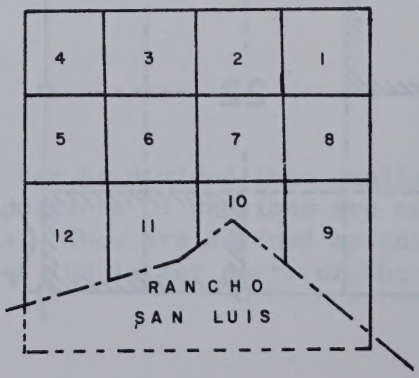
Each parcel may be divided into still smaller parcels by quartering the larger parcel.


West Half of Northwest Quarter Section
Northeast Quarter of Northeast Quarter Section
22
South Half of Southeast Quarter Section

In partial sections made fractional by rivers, lakes or other bodies of water, lots are formed along the border of water and are numbered consecutively through the section. The boundaries of these lots follow the section lines and contain as near to 40 acres as possible.



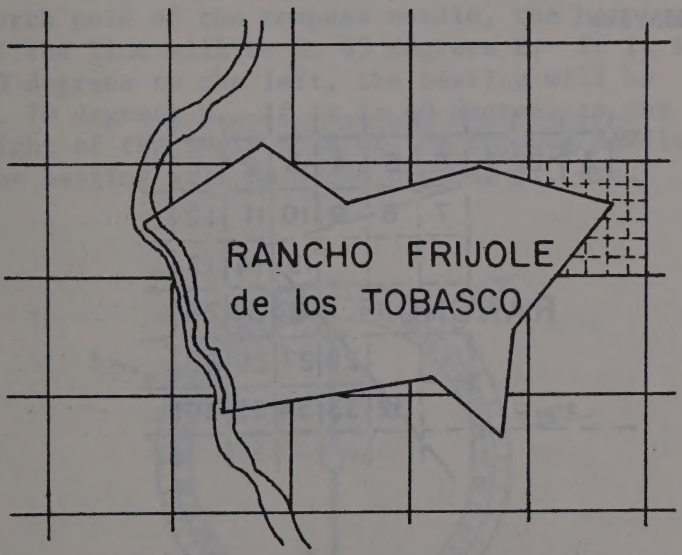
There are large areas in California, especially along the coast south of San Francisco that are covered by Spanish or Mexican Grants. These private grants are not covered in the rectangular survey. This situation requires the forming of lots along the grant boundaries, similar to those areas bordering rivers or lakes.



RANCHOS

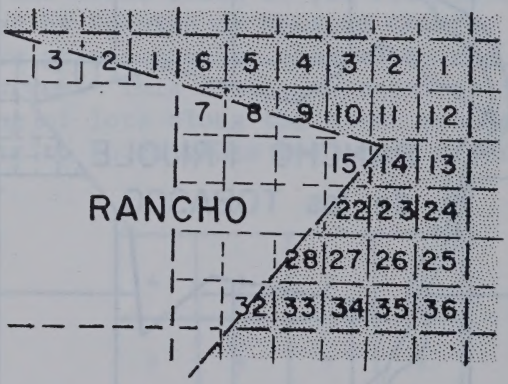
During the early Spanish development of California, there were no established base lines or reference lines to identify particular areas or tracts of land.

When certain areas of land were granted to Mexican settlers, they were called ranchos and given an identifying name. In order to define the limits of the rancho, it was necessary to identify the boundaries by certain landmarks or by measurements. Many of the old landmarks have since been destroyed or changed.



Measurements were made by the most practical means at hand. Linear measurements were usually either in varas (33 ins.) or in leagues (3 miles). To measure distances from a landmark, for instance, two men on horseback might drag a cord or rawhide thong line of perhaps 100 varas length, one standing still while the other rode ahead and then passing each other, repeating the "leap-frogging" while counting the 100 vara lengths. Most of these boundaries have since been reestablished by accurate conformation surveys and the lines are now identified by bearings and lengths in feet.

Because rancho boundaries were legally accepted as defining certain areas of land in California, they have been maintained through the years. When the State was subdivided into a gridiron of townships, ranges and sections, the lines were stopped at the rancho boundaries.



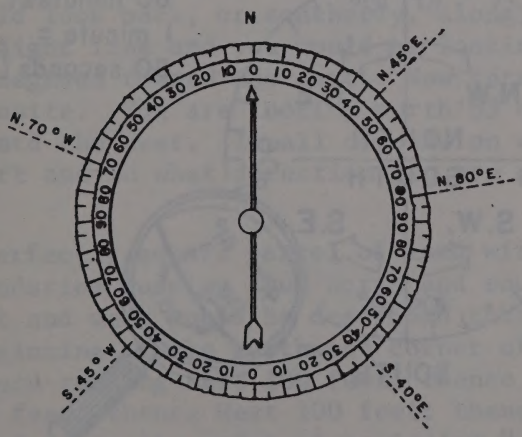
Where sections are not complete within a township because of irregular rancho lines, there is no change in the numbering of the sections. The same rule applies to township numbers.

BEARINGS AND DIRECTIONS

All bearings, in land surveying must be definitely and minutely described. It is not sufficient to describe a line or bearing as simply northeast or southwest. It must be described as so many degrees, minutes, and seconds in the direction in which the line is progressing. The accuracy of calculations is dependent on exact measurements of distances and bearings.

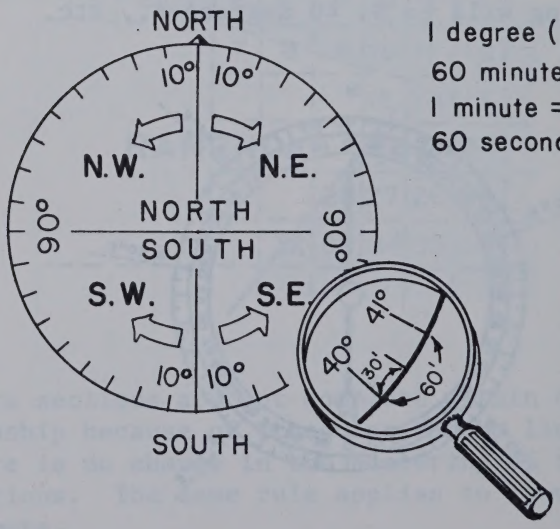
There are 360 degrees in a full circle, which is divided into four quadrants. Bearings are the angular measurement east or west of due north, and east or west of due south. Bearings do not go above 89°59'59".

The angle formed by the compass needle and a given line determines the bearing of the line. If the angle is 45 degrees to the right of the north pole of the compass needle, the bearing of the line will be N. 45 degrees E. If it is 70 degrees to the left, the bearing will be N. 70 degrees W. If it is 40 degrees to the right of the south pole of the compass needle, the bearing will be S. 40 degrees E., etc.



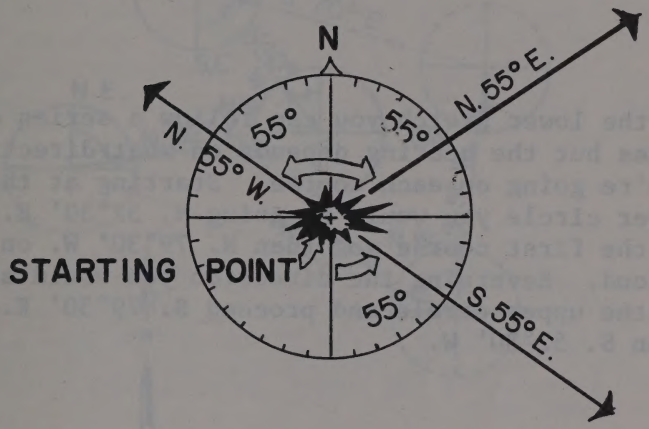
It should be noted that the compass needle follows the earth's magnetic meridian which rarely coincides with the true geographical meridian. The magnetic meridian is not stable, varying with different locations on the earth's surface and also from year to year. This difference is called Declination and may vary from 0 degrees to 25 degrees either east or west. Therefore, for all practical purposes, survey lines are corrected to true bearings based upon the earth's true geographical poles as determined by astronomical observations.

To simplify: Survey lines are considered first to be going generally north or generally south. In order to determine the correct bearing, say if the line is northerly, you must face the north point and then determine whether the line is going away from you toward the east or west.



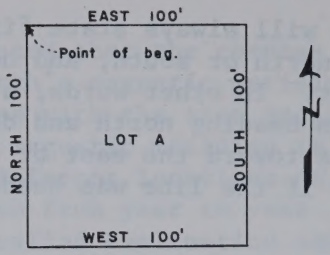
1 degree (°) =
60 minutes (')
1 minute =
60 seconds (")

The bearing will always state first the primary direction, north or south, and next the angle east or west. In other words, a line would be described as heading north and deflected so many degrees toward the east or west. The same would apply if the line was headed south.

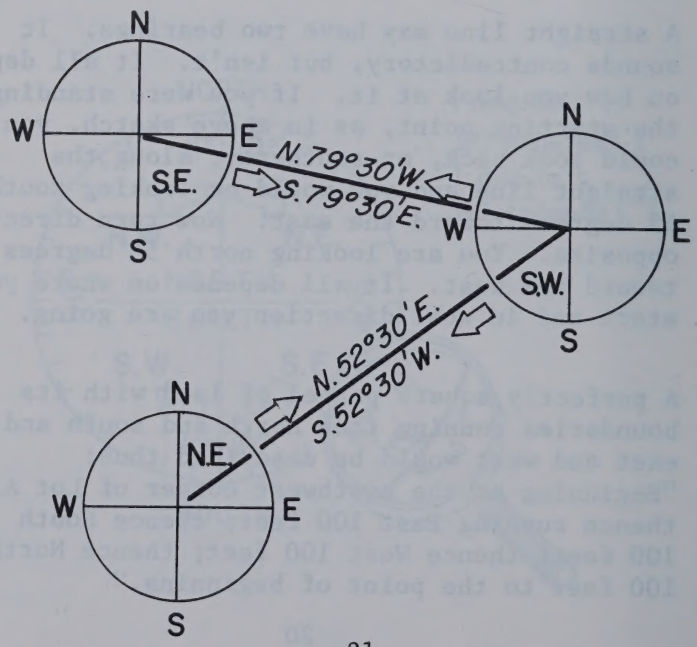


A straight line may have two bearings. It sounds contradictory, but isn't. It all depends on how you look at it. If you were standing at the starting point, as in above sketch, you could look back, or southerly, along the straight line and you would be looking south 55 degrees toward the east. Now turn directly opposite. You are looking north 55 degrees toward the west. It all depends on where you start and in what direction you are going.

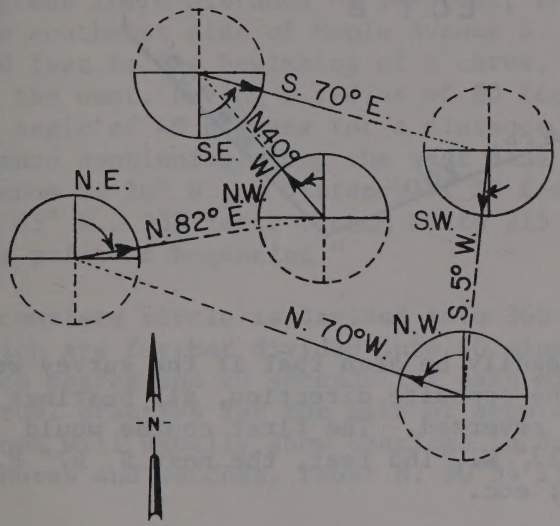
A perfectly square parcel of land with its boundaries running true north and south and east and west would be described thus: "Beginning at the northwest corner of Lot A; thence running East 100 feet; thence South 100 feet; thence West 100 feet; thence North 100 feet to the point of beginning."



In the lower sketch you can follow a series of lines but the bearing depends on what direction you're going on each course. Starting at the lower circle you would be going N. 52°30' E. on the first course and then N. 79°30' W. on the second. Reversing the direction you would start at the upper circle and proceed S. 79°30' E. and then S. 52°30' W.



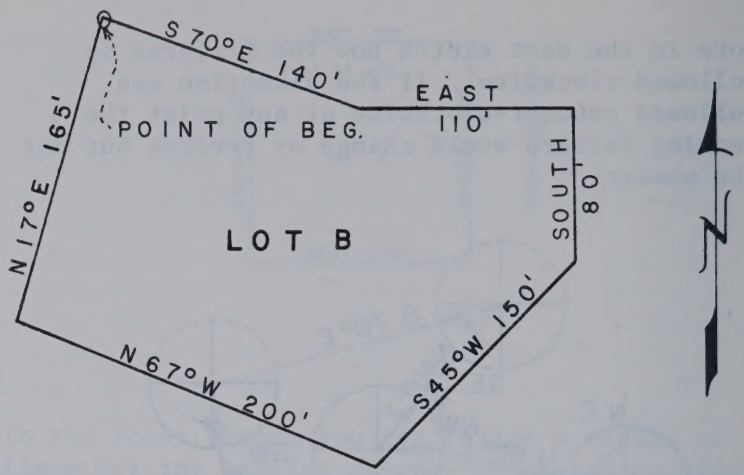
Note in the next sketch how the traverse is followed clockwise. If the direction was followed counter-clockwise at any point the bearing letters would change or reverse but not the number.



METES AND BOUNDS

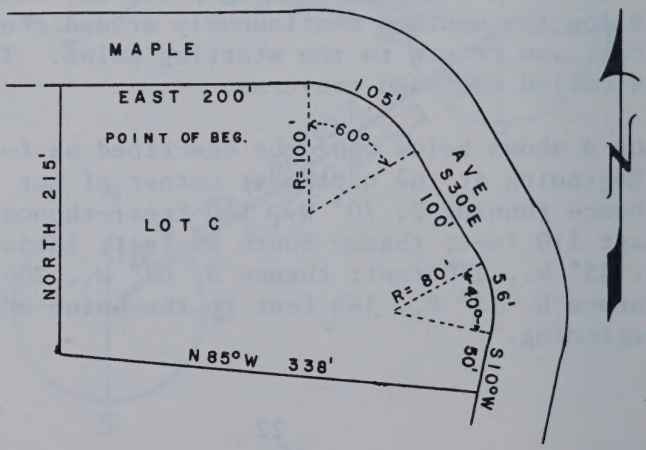
In determining the bearings for all the lines surrounding a tract of land, it is necessary to assume a logical starting point and then to follow the courses continuously around the tract and return to the starting point. This is called a closed traverse.

Lot B shown below would be described as follows: "Beginning at the northwest corner of Lot B; thence running S. 70° W., 140 feet; thence East 110 feet; thence South 80 feet; thence S. 45° W., 150 feet; thence N. 67° W., 200 feet; thence N. 17° E., 165 feet to the point of beginning."



It can readily be seen that if the survey were run in the opposite direction, all bearings would be reversed. The first course would read S. 17° W., 165 feet, the next S. 67° E., 200 feet; etc.

It is frequently the case that plots of land border on streets that consist of curves. The lot description must therefore include the curve dimensions.

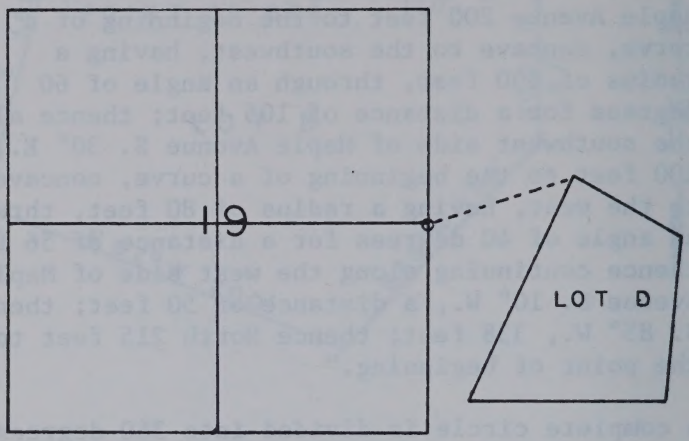


Lot C would be described as follows: "Beginning at point on the south side of Maple Avenue; thence running East along the south side of Maple Avenue 200 feet to the beginning of a curve, concave to the southwest, having a radius of 100 feet, through an angle of 60 degrees for a distance of 105 feet; thence along the southwest side of Maple Avenue S. 30° E., 100 feet to the beginning of a curve, concave to the west, having a radius of 80 feet, through an angle of 40 degrees for a distance of 56 feet; thence continuing along the west side of Maple Avenue S. 10° W., a distance of 50 feet; thence N. 85° W., 338 feet; thence North 215 feet to the point of beginning."

A complete circle is divided into 360 degrees which are further divided into 60 minutes for each degree and 60 seconds for each minute. In actual practice for the sake of accuracy, survey lines will usually show bearings in degrees, minutes and seconds, thus: N. 50°34'15" E.

The point of beginning of a survey is very important. Without it there can be no survey, and unless it is adequately and accurately defined the survey will be of little value. Where surveys are made in lands covered by the U.S. Rectangular Survey, known and established points in the government survey should be used as a reference for the point of beginning. In Spanish Grant areas, all surveys should be tied to some known and recognized point or corner in the boundary of the grant.

In the following illustration, Lot D has been tied to the northeast corner of the southeast quarter of Section 19. However, if the southeast corner of the southeast quarter can be located, it would make a better tie, it being closer.

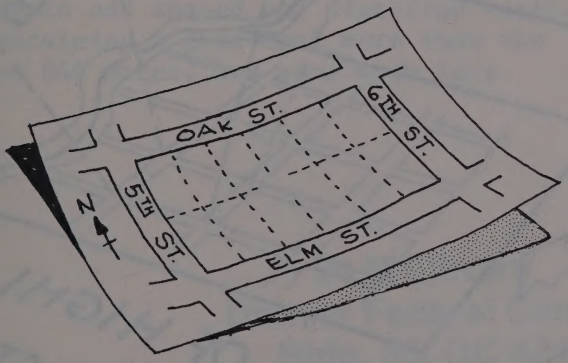


SUBDIVISIONS

All subdivision maps such as for housing developments must be placed on record with the County Recorder of the county where the land is located. These maps must be tied to known and established points in the U.S. Government survey or such other points as will make identification of the subdivision's location readily available. All lots in the subdivision will therefore be indirectly tied to the government survey. A deed description for one of these lots need only give the lot number and the recording data of the original subdivision map, for example: "Lot 7 of Rosewood Estates as shown on map thereof, recorded in Book 10 of Maps, page 231, Official Records of Humboldt County."

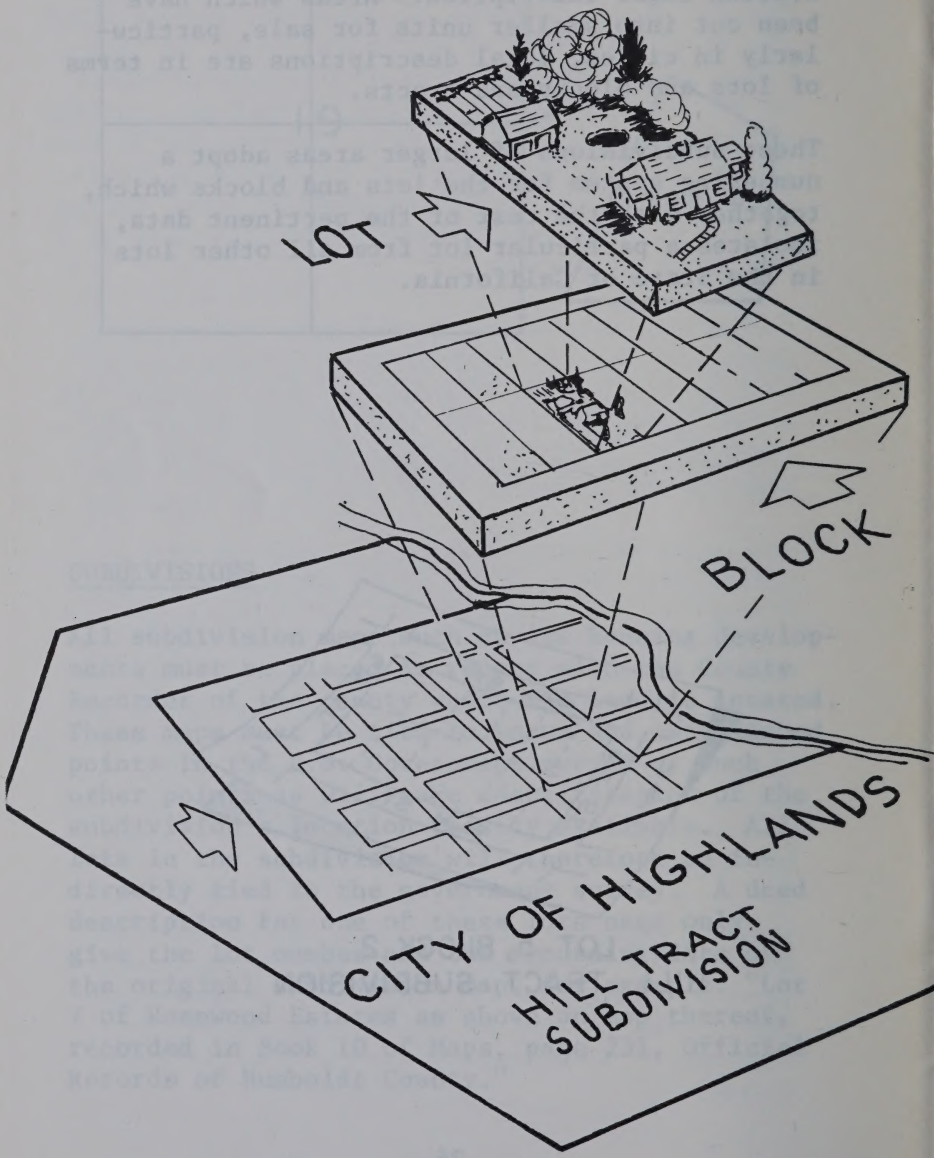
Every lot has its place on some map - At the office of the county recorder at each county seat in California, are filed official maps and other records of all the land in that county. Some areas are referred to by township-and-section legal description. Areas which have been cut into smaller units for sale, particularly in cities, legal descriptions are in terms of lots and blocks and tracts.

These subdivisions of larger areas adopt a numbering system for the lots and blocks which, together with the rest of the pertinent data, isolates a particular lot from all other lots in the State of California.



LOT 5, BLOCK 2
HILL TRACT SUBDIVISION

Legal description of this property - Lot 5 in Block 2 of Hill Tract in the City of Highlands, County of San Luis Obispo, State of California, as per map recorded in Book 77, page 48 of Maps, in the office of the Recorder of said county.



Topographical maps made by the U.S. Geological Survey show townships and ranges and numbered sections of the meridian controlling the area covered. Such maps cover a quadrangle of approximately 220 square miles and show most topographical features such as roads, streams, elevations, contours and prominent structures. These maps are inexpensive, and usually sell for one dollar.

Original surveys of the public lands were principally done under contract, the surveyor being paid a fixed sum per linear mile, ranging from $3 to $25 per mile, depending upon the importance of the line being run, whether base and meridians or individual section lines and also upon the type of terrain being surveyed, whether flat open plain or steep wooded mountain.

There were some inaccuracies in the original surveys. These show up on topographical maps of today as odd shaped and distorted sections, some containing a good deal more than the allotted 640 acres, and some much less.

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